

JAPANESE [JP,2002-369239,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE
INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

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CLAIMS

[Claim(s)]

[Claim 1] It is the communication system with which each of two or more of said networks consists of communication devices connected with two or more radio equipment and said two or more radio equipment by consisting of two or more networks. Which base station in the 1st network among said two or more networks The means which will rewrite the path information registered beforehand if the terminal from the 2nd network is detected, Have a means to transmit the detection information on said terminal to addressing to a communication device in said 1st network, and said communication device in said 1st network the communication system characterized by having the means which rewrites the path information beforehand registered based on the detection information on said terminal, and a means for the communication device in networks other than said 1st network to boil the detection information on said terminal, respectively, and to transmit.

[Claim 2] Each of the communication device in networks other than the 1st [said] network which received the detection information on said terminal is communication system according to claim 1 characterized by rewriting the path information beforehand registered based on the detection information on said terminal.

[Claim 3] If the terminal from the wireless area of the 2nd radio equipment in said 1st network is detected, the 1st radio equipment in said 1st network It has the means which rewrites the path information registered beforehand, and a means to transmit the detection information on said terminal to radio equipment other than said 1st radio equipment in said 1st network. Each of said radio equipment other than said 1st radio equipment is communication system according to claim 1 characterized by having the means which rewrites the path information registered beforehand, when the detection information on said terminal is received.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the communication system between road and car which realizes an intelligent transport system (ITS;Intelligent Transport Systems).

[0002]

[Description of the Prior Art] In order to realize service which aimed at improvement in safety, improvement in transportation efficiency, and improvement in the amenity in recent years, development of the intelligent transport system which used the road and the car as the system of one is furthered.

[0003] As one field of the intelligent transport system, he is a corporation. The electronic toll collection system (ETC:Electric Toll Collection System) given in the standard "the 551.2nd edition of turnpike electronic toll collection system standard ARIBSTD-T" (December 14, Heisei 11 1.2 amendment) defined in Association of Radio Industries and Businesses is known. An electronic toll collection system is a system between highway and vehicle which performs radio called dedicated short range communications (DSRC:Dedicated Short Range Communication) between the mounted terminal (mounted equipment) carried in the car, and the road-side equipment installed in the tollgate, and carries out automatic **** of the toll in the tollgate of a turnpike, without the car which passes through a tollgate stopping.

[0004] On the other hand, there is a request that he wants to apply IP (Internet Protocol) communication technology to an intelligent transport system, and to realize various communication service (IP packet communication), such as voice, data, and an image, with the explosive spread of the Internet in recent years. In this case, even if the terminal carried in the car moves, the technique (hand-over) which enables communicative continuation is needed.

[0005] As a technique of realizing hand-over, a regular mobile (Mobile) IP technique is in "RFC (Request For Comment: document which tells the information about the Internet)2002", for example. This technique is developed supposing the case where a terminal is mainly used, moving temporarily from the location currently originally used. The node by which a terminal is called a home agent (HA:Home Agent) to the network (home network: Home Network) to which it belongs usually is made to intervene. Moreover, the node called a foreign agent (FA:Foreign Agent) to the network (foreign network: Foreign Network) of a migration place is made to intervene. Once transmitting to a home agent, a transfer of a packet when a terminal moves to a foreign network from a home network is transmitted to foreign EJANTO, and is transmitted to a terminal.

[0006]

[Problem(s) to be Solved by the Invention] Since the electric wave of a microwave band is being used for above-mentioned dedicated short range communications, its range (wireless zone) which can radiocommunicate is as small as 30m, and they do not have the lap range of wireless zones, either. Therefore, in order for a car to continue and to enable IP communication link, without breaking off even if it moves such two or more wireless zones to a high speed, it is necessary to realize hand-over for a short time. Moreover, the packet from IP network once concentrates the above-mentioned mobile IP technique on a home agent. Therefore, when a mobile IP technique is applied to the system between highway and vehicle which very many cars

move to a high speed, the fall of a home agent's throughput, as a result decline in a network utilization ratio will be caused.

[0007] The purpose of this invention is in view of the above point to offer the communication system which can realize hand-over in a short time.

[0008] Other purposes of this invention are to offer the communication system which can realize hand-over, without reducing a network utilization ratio.

[0009]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the communication system of this invention It is the communication system with which each of two or more of said subnets consists of the gateways connected with two or more base stations and said two or more base stations by consisting of two or more subnets. Which base station in the 1st subnet among said two or more subnets The means which will rewrite the path information registered beforehand if the terminal from the 2nd subnet is detected, Have a means to transmit the detection information on said terminal to addressing to the gateway in said 1st subnet, and said gateway in said 1st subnet It has the means which rewrites the path information beforehand registered based on the detection information on said terminal, and a means to transmit the detection information on said terminal to each of the gateway in subnets other than said 1st subnet. Each of the gateway in subnets other than the 1st [said] subnet which received the detection information on said terminal has the means which rewrites the path information beforehand registered based on the detection information on said terminal.

[0010] Moreover, the 1st base station in said 1st subnet If the terminal from the wireless area of the 2nd base station in said 1st subnet is detected It has the means which rewrites the path information registered beforehand, and a means to transmit the detection information on said terminal to base stations other than said 1st base station in said 1st subnet. Each of said base stations other than said 1st base station has the means which rewrites the path information registered beforehand, when the detection information on said terminal is received.

[0011]

[Embodiment of the Invention] Hereafter, the operation gestalt of the communication system by this invention is explained to a detail with reference to a drawing.

[0012] Drawing 1 is drawing showing the configuration of the whole communication system of this invention.

[0013] The communication system of this invention consists of the network 110 (a subnet 110 is called hereafter), a subnet 111, a subnet 112, and an IP network (for example, mobile IP network) 120 that IP communication link should be made possible in a system between highway and vehicle. The subnet 110 consists of the gateways (communication device) 130 connected with the communication network 150 connected with two or more base stations (radio equipment) 140-1 installed in the road side of a road - 140-n, and a base station 140-1 - 140-n, and the communication network 150. In addition, among drawing, 101-1 - 101-n show the wireless zone of a base station 140-1 - 140-n, respectively, and are. Moreover, the identification address (for example, AA.AA.AA.AA) for identifying the mounted terminal 104 is given to the mounted terminal 104 carried in the vehicle 100. The subnet 111 and the subnet 112 also have the same composition as a subnet 110.

[0014] Moreover, the gateways 130-132 are connected with the IP network 220 in this invention. Furthermore, in this invention, the gateways 130-132 interconnect with the gateway connection network 221, respectively. Moreover, in this invention, each of the gateways 130-132 has managed the destination information on each base station which a subordinate has. The gateways 130-132 carry out the multiple address transfer of the packet from the IP network 220 at each addressing to a base station of a subordinate, respectively.

[0015] Although a detail is mentioned later, the base station 140-1 by this invention - 140-n have managed the path information on the mounted terminal in a subordinate, respectively. When a mounted terminal moves into the same subnet between base stations, a migration place base station detects a terminal and the identification address of the terminal, and rewrites the contents of the path information on the mounted terminal registered beforehand. Moreover, a migration place base station notifies the purport that the mounted terminal was detected to

addressing to a base station of the others which belong in the same subnet. Other base stations which received the notice of terminal detection rewrite the contents of the path information on a mounted terminal based on the contents. By the above actuation, the packet from the IP network 120 is transmitted to the mounted terminal of a migration place.

[0016] Moreover, each of the gateways 130-132 has managed the information (for example, identification address) and path information on a mounted terminal belonging to a subnet. When a mounted terminal moves between subnets, the base station belonging to a migration place subnet rewrites the path information beforehand registered like the above. Moreover, the above-mentioned base station notifies the identification address of a mounted terminal to the gateway and other base stations in the same subnet. The gateway which received the notice rewrites the contents of terminal information and path information, and notifies the purport that the mounted terminal was detected to the gateway belonging to other subnets. Moreover, the base station which received the notice rewrites the contents of path information. The contents of the above-mentioned information into which the gateway belonging to other subnets and a base station are registered beforehand similarly are rewritten. By the above actuation, the packet from the IP network 120 is transmitted to the mounted terminal of a migration place.

[0017] Drawing 2 is the block diagram showing the configuration of the gateway 130 of this invention. The gateway 131 and the gateway 132 also have the same composition as the gateway 130.

[0018] The gateway 130 consists of IP network interface 200-1, the base station interface 200-2, the gateway connection network interface 200-3, the routing section 201, the message-processing section 202, and a control section 203. Furthermore, a control section 203 is equipped with a processor 220, the program storing memory 221, the identification address managed table 222, and routing table 223, and controls the gateway 130 whole in generalization.

[0019] Here, the gateway connection network interface 200-3 transmits the packet 211 which received from the gateway 131 or the gateway 132 to the routing section 201. Messages, such as terminal detection information for rewriting the contents (terminal information) of the identification address managed table 222 and the contents (path information) of routing table 223, are contained in the above-mentioned packet 211. The routing section 201 transmits the packet 211 which received from the gateway connection network interface 200-3 to the message-processing section 202. The message-processing section 202 assembles the packet 211 which received from the routing section 201 in a message 212, and transmits to a control section 203. The processor 220 with which a control section 203 is equipped analyzes the contents of the message, and rewrites the contents of the identification address managed table 222 and routing table 223.

[0020] Moreover, the above-mentioned message-processing section 202 assembles the message 212 which received from the control section 203 to a packet 211, and transmits to the routing section 201. The routing section 201 transmits the packet 211 which received from the message-processing section 202 to the gateway connection network interface 200-3. The gateway connection network interface 200-3 transmits the packet 211 which received from the routing section 201 to the gateway connection network 121.

[0021] Next, the packet 210 which received from the IP network 220 is transmitted to the routing section 201 through IP network interface 200-1. The routing section 201 exchanges for the base station interface 200-2 the packet 210 which received from IP network interface 200-1 based on routing table 223 (switching). The base station interface 200-2 carries out the multiple address transfer of the packet 210 which received from the routing section 201 at a base station 140-1 - addressing to 140-n. Similarly, the packet from a base station 140-1 - 140-n is transmitted to the IP network 220 through the base station interface 200-2, the routing section 201, and IP network interface 200-1.

[0022] In addition, the base station interface 200-1 mentioned above may be established for every base station. Moreover, it may be made to perform processing of the message-processing section 202 mentioned above by the control section 203.

[0023] Drawing 3 is the block diagram showing the configuration of the base station 140-1 of this invention. A base station 140-2 - 24-n also have the same composition as a base station 140-1.

[0024] The base station 140-1 consists of the gateway, the base station interface 300-1, a terminal interface 300-2, the routing section 301, the message-processing section 302, and a control section 303. Furthermore, a control section 303 is equipped with a processor 320, the program storing memory 321, and routing table 322, and controls the 140 to base station 1 whole in generalization.

[0025] In addition, since the actuation in each part of the routing section 301, the message-processing section 302, and a control section 303 is the same as that of the routing section 201 shown in drawing 2 R> 2, the message-processing section 202, and a control section 203, detailed explanation is omitted here.

[0026] The packet 211 containing a message is transmitted to a control section 303 through the gateway, the base station interface 300-1, the routing section 301, and the message-processing section 302. Similarly, the packet containing the message from a control section 303 is transmitted to the gateway and the base station interface 300-1 through the message-processing section 302 and the routing section 301.

[0027] Moreover, the packet 210 from the IP network 220 is transmitted to a terminal interface 300-2 through the gateway, the base station interface 300-1, and the routing section 301. A terminal interface 300-2 transmits the packet 210 which received from the routing section 301 to a mounted terminal. Similarly, the packet 210 from a mounted terminal is transmitted to the gateway and the base station interface 300-1 through a terminal interface 300-2 and the routing section 301.

[0028] Drawing 4 is drawing showing the configuration of the identification address managed table 322 with which the gateway of this invention is equipped.

[0029] An identification address 400, an operating condition 401, an affiliation subnet 402, and each area of an expiration date 403 are consisted of by the identification address managed table 222. The identification address in use or the identification address which can be given to a mounted terminal is stored in the identification address 400. The information showing whether each identification address stored in the area of an identification address 400 is used for the mounted terminal is stored in the operating condition 401. When the identification address is used for the mounted terminal by the affiliation subnet 402, the subnet name to which the mounted terminal belongs is stored in it. The expiration date of the identification address currently used for the mounted terminal is stored in the expiration date 403.

[0030] Drawing 5 is drawing showing the configuration of the routing table 223 with which the gateway of this invention is equipped.

[0031] It consists of each area of the output destination change 501 which shows the identification address 500 of a mounted terminal, and the output destination change of a packet in routing table 223.

[0032] Drawing 6 is drawing showing the configuration of the routing table 322 with which the base station of this invention is equipped.

[0033] An identification address 600, an output destination change 601 which shows the output destination change of a packet, and each area of the existence 602 of a base station subordinate are consisted of by routing table 322. The information showing whether the mounted terminal which has each identification address stored in the identification address 600 exists in the subordinate of the base station is stored in the existence 602 of a base station subordinate.

[0034] Drawing 7 is drawing showing an example of the description of this invention.

[0035] The example shown in drawing 7 shows the terminal detection message 212 used when a mounted terminal moves between the base station in the same subnet, or a subnet. The terminal detection message 212 consists of the detection terminal identification address 700 which stores the identification address of the detected mounted terminal, and each area of the message-sending former subnet name 701 which stores the subnet name by which the mounted terminal was detected.

[0036] In addition, although mentioned later, the message which it uses when the mounted terminal which has an identification address breaks away out of communication system (drawing 1) is called the identification address disconnection informative message 212. It is contained in

the message 212 as an identification address which the identification address of the mounted terminal should open wide. The grant of the identification address opened wide to other mounted terminals is attained.

[0037] Drawing 8 is the flow Fig. showing actuation of communication system when a mounted terminal goes into the subordinate of a subnet (for example, subnet 110) for the first time.

[0038] Detection of a new mount terminal of the processor 320 with which the control section 303 of a base station 140-1 is equipped requires the identification address which can be given to the new mount terminal of the gateway 130 (S801). (step S800)

[0039] The processor 220 with which the control section 203 of the gateway 130 is equipped will acquire an empty identification address (for example, AA.AA.AA.AA) with reference to the operating condition 401 of the identification address managed table 222, if a demand is received (S802). Next, a processor 220 notifies the acquired identification address to a base station 140-1 (S803).

[0040] "AA.AA.AA.AA" will be set as the identification address 600 of routing table 322, and the processor 320 with which the control section 303 of a base station 140-1 is equipped will set "*" as the existence 602 of "a terminal interface 300-2" and a base station subordinate in an output destination change 601, respectively, if a notice is received (S804, drawing 6).

[0041] Moreover, the processor 220 with which the control section 203 of the gateway 130 is equipped sets "under use" as the operating condition 401 of "AA.AA.AA.AA", and sets "a subnet 210" as the affiliation subnet 402, respectively. Furthermore, a processor 220 sets "AA.AA.AA.AA" as the identification address 500 of routing table 223, and sets "the base station interface 200-2" as an output destination change 501 (S805, drawing 4 R> 4, drawing 5). Next, a processor 220 generates the packet 211 containing the terminal detection message 212 (drawing 7), and transmits to a base station 140-2 - addressing to 140-n (S806).

[0042] "AA.AA.AA.AA" will be set as the identification address 600 of routing table 322, and the processor 320 with which the control section 303 of a base station 140-2 - 240-n is equipped will set "nothing" as the existence 602 of "a terminal interface 300-2" and a base station subordinate in an output destination change 601, if a notice is received (S807, drawing abbreviation).

[0043] Moreover, the processor 220 with which the control section 203 of the gateway 130 is equipped transmits the above-mentioned packet 211 also to the gateway 131 and addressing to 132 (S808). This packet 211 is transmitted to the gateways 131 and 132 through the gateway connection network 121.

[0044] The processor 220 with which the control section 203 of the gateways 131 and 132 is equipped searches the identification address 400 of the identification address managed table 222 based on the detection terminal identification address "AA.AA.AA.AA" (drawing 7) included in the terminal detection message 212. When there is an identification address "AA.AA.AA.AA" which is in agreement with an identification address 700, a processor 220 sets "under use" as an operating condition 401. Moreover, a processor 220 sets "a subnet 110" as the affiliation subnet 502 based on the message-sending former subnet name "a subnet 110" included in the terminal detection message 212 (S809, drawing 4). In addition, when the corresponding identification address does not exist, a processor 220 newly creates an entry after the entry of the identification address which can be given. Based on the terminal detection message 212, "AA.AA.AA.AA" is set as an identification address 400 and, as for it, a processor 220 sets "a subnet 110" as an operating condition 401 "during use" at the affiliation subnet 402.

[0045] Furthermore, the processor 220 with which the control section 203 of the gateway 130 is equipped notifies an identification address "AA.AA.AA.AA" to the IP network 120 (S810). By the above actuation, the packet addressed to the above-mentioned mounted terminal from the IP network 120 is transmitted to a mounted terminal through the gateway 130 and a base station 140-1.

[0046] Drawing 9 is the flow Fig. showing communication system actuation when a mounted terminal moves between the base stations in the same subnet (for example, subnet 110).

[0047] For example, when the mounted terminal 104 (identification address "AA.AA.AA.AA") moves to wireless zone 101-[of base station 140-n] n from the wireless zone 101-1 of a base

station 140-1, the terminal interface 300-2 with which base station 140-n is equipped detects the mounted terminal 104 (S900). Next, the processor 320 with which the control section 303 of base station 140-n is equipped analyzes the message 212 which received, and detects an identification address "AA.AA.AA.AA" (S901). Next, a processor 320 carries out the multiple address transfer of the packet 211 containing the terminal detection message 212 (drawing 7) which made "the subnet 110" "AA.AA.AA.AA" and a message-sending former subnet name for the identification address at the gateway 130, a base station 140-1 - 140- (n-1) (S902, S903). Moreover, a processor 320 rewrites the existence 602 of the base station subordinate of routing table 322 from "nothing" to "**" (S904, drawing 11 R> 1).

[0048] Next, the processor 320 with which the control section 303 of a base station 140-1 - 140- (n-1) is equipped analyzes the terminal detection message 212 which received. A processor 320 searches the identification address 600 of routing table 322 based on the detection terminal identification address "AA.AA.AA.AA" included in the terminal detection message 212. When a processor 320 has an identification address "AA.AA.AA.AA" and the existence 602 of a base station subordinate serves as "**", "nothing" is set as the existence 602 of a base station subordinate (S905). Here, the existence 602 of the base station subordinate of the routing table 322 with which a base station 140-1 is equipped writes and replaces "nothing" from "**" (drawing 11).

[0049] Moreover, the processor 220 with which the control section 203 of the gateway 130 is equipped analyzes the terminal detection message 212 which received. A processor 220 checks that the message-sending former subnet name 701 contained in the terminal detection message 212 is "a subnet 110", and discards the terminal detection message 212 (S906). By the above actuation, the packet from the IP network 120 comes (drawing 11) to be transmitted to the mounted terminal 104 of a migration place through base station 140-n.

[0050] Drawing 10 is the flow Fig. showing actuation of the communication system at the time of moving between the subnets from which a mounted terminal differs.

[0051] For example, when the mounted terminal 104 (identification address "AA.AA.AA.AA") moves to the wireless zone 141-1 of the base station 141-1 belonging to a subnet 111 from wireless zone 140- [of base station 140-n belonging to a subnet 110] n, the terminal interface 300-2 with which a base station 141-1 is equipped detects the mounted terminal 104 (1000). Next, the processor 320 with which the control section 303 of a base station 141-1 is equipped analyzes the message 212 which received, and detects an identification address "AA.AA.AA.AA" (S1001). Next, a processor 320 carries out the multiple address transfer of the packet 211 containing the terminal detection message 212 which made "the subnet 111" "AA.AA.AA.AA" and a message-sending former subnet name for the identification address at the gateway 131, a base station 141-2 - 141-n (S1002, S1003). Moreover, a processor 320 sets "AA.AA.AA.AA" as the identification address 600 of routing table 322, and sets "**" as "the base station interface 300-2" and the existence 602 of a base station subordinate in an output destination change 601 (S1004, drawing 12).

[0052] The processor 220 with which the control section 203 of the gateway 131 is equipped analyzes the terminal detection message 212 which received. A processor 220 rewrites the affiliation subnet 402 of the identification address managed table 222 from a subnet 110 to a subnet 111 based on the contents of the terminal detection message 212 (drawing 12). Moreover, although not illustrated, "AA.AA.AA.AA" is set as the identification address 500 of routing table 223, and "the base station interface 200-2" is set as an output destination change 501 (S1005).

[0053] The processor 320 with which the control section 303 of a base station 141-2 - 141-n is equipped analyzes the terminal detection message 212 which received. Although not illustrated, based on the contents of the terminal detection message 212, "AA.AA.AA.AA" is set as the identification address 600 of routing table 322, and a processor 320 sets "nothing" as the existence 602 of "a terminal interface 300-2" and a base station subordinate in an output destination change 601 (S1006).

[0054] Next, the processor 220 with which the control section 203 of the gateway 131 is equipped carries out the multiple address transfer of the packet 211 containing the terminal

detection message 212 which made "the subnet 111" "AA.AA.AA.AA" and a message-sending former subnet name for the identification address after processing of S1005 in the gateways 130 and 132 belonging to other subnets 110 and 112 (S1007).

[0055] Next, the processor 220 with which the control section 203 of the gateways 130 and 132 is equipped analyzes the terminal detection message 212 which received. A processor 220 rewrites the affiliation subnet 402 corresponding to "AA.AA.AA.AA" in the identification address 400 of the identification address managed table 222 from a subnet 110 to a subnet 111 based on the contents of the terminal detection message 212 (S1008, drawing 12). In addition, in the gateway 132, although not shown clearly, since a moved material subnet is a subnet 110, processing is ended. In routing table 223, as for the gateway 130 belonging to the moved material subnet 110, an identification address 500 deletes the area of "AA.AA.AA.AA." Next, the processor 220 with which the control section 203 of the gateway 130 is equipped carries out the multiple address transfer of the terminal detection message 212 which received at a base station 140-1 - 140-n (1009).

[0056] Although not illustrated, as for the processor 320 with which the control section 303 of a base station 140-1 - 140-n is equipped, an identification address 500 deletes the area of "AA.AA.AA.AA" (S1010, drawing 12). Furthermore, the processor 220 with which the control section 203 of the gateway 131 is equipped notifies an identification address "AA.AA.AA.AA" after processing of S1007 (S1011). By the above actuation, the packet from the IP network 120 comes (drawing 11) to be transmitted to the mounted terminal 104 of a migration place through a base station 141-1.

[0057] Drawing 12 is the flow Fig. showing actuation when the expiration date 403 of an identification address carries out a time-out (the value of an expiration date 403 is zero).

[0058] For example, the processor 220 with which the control section 203 of the gateway 130 is equipped executes an ICMP echo command towards the terminal in which the affiliation subnet 402 of the identification address managed table 222 has this identification address when an expiration date 403 carries out a time-out about the entry of "the gateway 130" (1300). A processor 220 judges the existence of the response from a terminal (1301). If there is a response from a terminal, a processor 220 will reset an expiration date 403 to a certain fixed value (1302), and will notify the renewal of an expiration date 403 to the gateways 131 and 232 belonging to other subnets 111 and 112 (1303). The processor 220 with which the control section 203 of the gateways 131 and 232 which received the notice is equipped resets the expiration date 403 of the corresponding identification address to a certain fixed value (1310). The processor 220 with which the control section 203 of the gateway 130 will be equipped if a terminal to a response cannot be found judges whether it is the identification address which self gave from the entry location of the identification address managed table 322 (1304). If it is the identification address which self gave, the processor 220 with which the control section 203 of the gateway 130 is equipped will set the operating condition 401 of the identification address managed table 222 as an opening (1305). Moreover, with the identification address which self gave, if there is nothing, the processor 220 with which the control section 203 of the gateway 130 is equipped will delete the entry of this identification address of the identification address managed table 322 (1306). Then, the processor 220 with which the control section 203 of the gateway 130 is equipped deletes an element with this identification address from routing table 223 (1307). Furthermore, the processor 220 with which the control section 203 of the gateway 130 is equipped makes the open identification address contained in the identification address disconnection informative message 212 the identification address of the terminal which did not answer, and it sends out to the base station 140-1 in the same subnet 110 - 140-n, and the gateways 131 and 232 belonging to other subnets 111 and 112 by the multiple address (1308). The processor 320 with which the control section 303 of the base station 140-1 - 140-n which received the identification address disconnection informative message 212 is equipped deletes an element with the identification address shown in the open identification address contained in the identification address disconnection informative message 212 from routing table 322 (1309). The processor 220 with which the control section 203 of the gateways 131 and 132 which received the identification address disconnection informative message 212 is equipped About the

identification address shown in an open identification address, from the entry location of the identification address managed table 222. If it is the identification address which judged whether it was the identification address which the gateway 130 gave, and the gateway 130 gave. The operating condition 401 of the identification address managed table 222 is set as an opening, and if it is not the identification address which the gateway 130 gave, the entry of this identification address of the identification address managed table 222 will be deleted (1310). The entry about the terminal which moved out of the network by the above actuation is deleted.

[0059]

[Effect of the Invention] According to this invention, the communication system which can realize hand-over in a short time can be offered.

[0060] Moreover, according to this invention, the communication system which can realize hand-over can be offered, without reducing a network utilization ratio.

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the communication system between road and car which realizes an intelligent transport system (ITS;Intelligent Transport Systems).

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PRIOR ART

[Description of the Prior Art] In order to realize service which aimed at improvement in safety, improvement in transportation efficiency, and improvement in the amenity in recent years, development of the intelligent transport system which used the road and the car as the system of one is furthered.

[0003] As one field of the intelligent transport system, he is a corporation. The electronic toll collection system (ETC:Electric Toll Collection System) given in the standard "the 551.2nd edition of turnpike electronic toll collection system standard ARIBSTD-T" (December 14, Heisei 11 1.2 amendment) defined in Association of Radio Industries and Businesses is known. An electronic toll collection system is a system between highway and vehicle which performs radio called dedicated short range communications (DSRC:Dedicated Short Range Communication) between the mounted terminal (mounted equipment) carried in the car, and the road-side equipment installed in the tollgate, and carries out automatic **** of the toll in the tollgate of a turnpike, without the car which passes through a tollgate stopping.

[0004] On the other hand, there is a request that he wants to apply IP (Internet Protocol) communication technology to an intelligent transport system, and to realize various communication service (IP packet communication), such as voice, data, and an image, with the explosive spread of the Internet in recent years. In this case, even if the terminal carried in the car moves, the technique (hand-over) which enables communicative continuation is needed.

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EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, the communication system which can realize hand-over in a short time can be offered.

[0060] Moreover, according to this invention, the communication system which can realize hand-over can be offered, without reducing a network utilization ratio.

[Translation done.]

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Since the electric wave of a microwave band is being used for above-mentioned dedicated short range communications, its range (wireless zone) which can radiocommunicate is as small as 30m, and they do not have the lap range of wireless zones, either. Therefore, in order for a car to continue and to enable IP communication link, without breaking off even if it moves such two or more wireless zones to a high speed, it is necessary to realize hand-over for a short time. Moreover, the packet from IP network once concentrates the above-mentioned mobile IP technique on a home agent. Therefore, when a mobile IP technique is applied to the system between highway and vehicle which very many cars move to a high speed, the fall of a home agent's throughput, as a result decline in a network utilization ratio will be caused.

[0007] The purpose of this invention is in view of the above point to offer the communication system which can realize hand-over in a short time.

[0008] Other purposes of this invention are to offer the communication system which can realize hand-over, without reducing a network utilization ratio.

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MEANS

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the communication system of this invention It is the communication system with which each of two or more of said subnets consists of the gateways connected with two or more base stations and said two or more base stations by consisting of two or more subnets. Which base station in the 1st subnet among said two or more subnets The means which will rewrite the path information registered beforehand if the terminal from the 2nd subnet is detected, Have a means to transmit the detection information on said terminal to addressing to the gateway in said 1st subnet, and said gateway in said 1st subnet It has the means which rewrites the path information beforehand registered based on the detection information on said terminal, and a means to transmit the detection information on said terminal to each of the gateway in subnets other than said 1st subnet. Each of the gateway in subnets other than the 1st [said] subnet which received the detection information on said terminal has the means which rewrites the path information beforehand registered based on the detection information on said terminal.

[0010] Moreover, the 1st base station in said 1st subnet If the terminal from the wireless area of the 2nd base station in said 1st subnet is detected It has the means which rewrites the path information registered beforehand, and a means to transmit the detection information on said terminal to base stations other than said 1st base station in said 1st subnet. Each of said base stations other than said 1st base station has the means which rewrites the path information registered beforehand, when the detection information on said terminal is received.

[0011]

[Embodiment of the Invention] Hereafter, the operation gestalt of the communication system by this invention is explained to a detail with reference to a drawing.

[0012] Drawing 1 is drawing showing the configuration of the whole communication system of this invention.

[0013] The communication system of this invention consists of the network 110 (a subnet 110 is called hereafter), a subnet 111, a subnet 112, and an IP network (for example, mobile IP network) 120 that IP communication link should be made possible in a system between highway and vehicle. The subnet 110 consists of the gateways (communication device) 130 connected with the communication network 150 connected with two or more base stations (radio equipment) 140-1 installed in the road side of a road - 140-n, and a base station 140-1 - 140-n, and the communication network 150. In addition, among drawing, 101-1 - 101-n show the wireless zone of a base station 140-1 - 140-n, respectively, and are. Moreover, the identification address (for example, AA.AA.AA.AA) for identifying the mounted terminal 104 is given to the mounted terminal 104 carried in the vehicle 100. The subnet 111 and the subnet 112 also have the same composition as a subnet 110.

[0014] Moreover, the gateways 130-132 are connected with the IP network 220 in this invention. Furthermore, in this invention, the gateways 130-132 interconnect with the gateway connection network 221, respectively. Moreover, in this invention, each of the gateways 130-132 has managed the destination information on each base station which a subordinate has. The gateways 130-132 carry out the multiple address transfer of the packet from the IP network 220 at each addressing to a base station of a subordinate, respectively.

[0015] Although a detail is mentioned later, the base station 140-1 by this invention - 140-n have managed the path information on the mounted terminal in a subordinate, respectively. When a mounted terminal moves into the same subnet between base stations, a migration place base station detects a terminal and the identification address of the terminal, and rewrites the contents of the path information on the mounted terminal registered beforehand. Moreover, a migration place base station notifies the purport that the mounted terminal was detected to addressing to a base station of the others which belong in the same subnet. Other base stations which received the notice of terminal detection rewrite the contents of the path information on a mounted terminal based on the contents. By the above actuation, the packet from the IP network 120 is transmitted to the mounted terminal of a migration place.

[0016] Moreover, each of the gateways 130-132 has managed the information (for example, identification address) and path information on a mounted terminal belonging to a subnet. When a mounted terminal moves between subnets, the base station belonging to a migration place subnet rewrites the path information beforehand registered like the above. Moreover, the above-mentioned base station notifies the identification address of a mounted terminal to the gateway and other base stations in the same subnet. The gateway which received the notice rewrites the contents of terminal information and path information, and notifies the purport that the mounted terminal was detected to the gateway belonging to other subnets. Moreover, the base station which received the notice rewrites the contents of path information. The contents of the above-mentioned information into which the gateway belonging to other subnets and a base station are registered beforehand similarly are rewritten. By the above actuation, the packet from the IP network 120 is transmitted to the mounted terminal of a migration place.

[0017] Drawing 2 is the block diagram showing the configuration of the gateway 130 of this invention. The gateway 131 and the gateway 132 also have the same composition as the gateway 130.

[0018] The gateway 130 consists of IP network interface 200-1, the base station interface 200-2, the gateway connection network interface 200-3, the routing section 201, the message-processing section 202, and a control section 203. Furthermore, a control section 203 is equipped with a processor 220, the program storing memory 221, the identification address managed table 222, and routing table 223, and controls the gateway 130 whole in generalization.

[0019] Here, the gateway connection network interface 200-3 transmits the packet 211 which received from the gateway 131 or the gateway 132 to the routing section 201. Messages, such as terminal detection information for rewriting the contents (terminal information) of the identification address managed table 222 and the contents (path information) of routing table 223, are contained in the above-mentioned packet 211. The routing section 201 transmits the packet 211 which received from the gateway connection network interface 200-3 to the message-processing section 202. The message-processing section 202 assembles the packet 211 which received from the routing section 201 in a message 212, and transmits to a control section 203. The processor 220 with which a control section 203 is equipped analyzes the contents of the message, and rewrites the contents of the identification address managed table 222 and routing table 223.

[0020] Moreover, the above-mentioned message-processing section 202 assembles the message 212 which received from the control section 203 to a packet 211, and transmits to the routing section 201. The routing section 201 transmits the packet 211 which received from the message-processing section 202 to the gateway connection network interface 200-3. The gateway connection network interface 200-3 transmits the packet 211 which received from the routing section 201 to the gateway connection network 121.

[0021] Next, the packet 210 which received from the IP network 220 is transmitted to the routing section 201 through IP network interface 200-1. The routing section 201 exchanges for the base station interface 200-2 the packet 210 which received from IP network interface 200-1 based on routing table 223 (switching). The base station interface 200-2 carries out the multiple address transfer of the packet 210 which received from the routing section 201 at a base station 140-1 - addressing to 140-n. Similarly, the packet from a base station 140-1 - 140-n is transmitted to the IP network 220 through the base station interface 200-2, the routing section

201, and IP network interface 200-1.

[0022] In addition, the base station interface 200-1 mentioned above may be established for every base station. Moreover, it may be made to perform processing of the message-processing section 202 mentioned above by the control section 203.

[0023] Drawing 3 is the block diagram showing the configuration of the base station 140-1 of this invention. A base station 140-2 - 24-n also have the same composition as a base station 140-1.

[0024] The base station 140-1 consists of the gateway, the base station interface 300-1, a terminal interface 300-2, the routing section 301, the message-processing section 302, and a control section 303. Furthermore, a control section 303 is equipped with a processor 320, the program storing memory 321, and routing table 322, and controls the 140 to base station 1 whole in generalization.

[0025] In addition, since the actuation in each part of the routing section 301, the message-processing section 302, and a control section 303 is the same as that of the routing section 201 shown in drawing 2 R> 2, the message-processing section 202, and a control section 203, detailed explanation is omitted here.

[0026] The packet 211 containing a message is transmitted to a control section 303 through the gateway, the base station interface 300-1, the routing section 301, and the message-processing section 302. Similarly, the packet containing the message from a control section 303 is transmitted to the gateway and the base station interface 300-1 through the message-processing section 302 and the routing section 301.

[0027] Moreover, the packet 210 from the IP network 220 is transmitted to a terminal interface 300-2 through the gateway, the base station interface 300-1, and the routing section 301. A terminal interface 300-2 transmits the packet 210 which received from the routing section 301 to a mounted terminal. Similarly, the packet 210 from a mounted terminal is transmitted to the gateway and the base station interface 300-1 through a terminal interface 300-2 and the routing section 301.

[0028] Drawing 4 is drawing showing the configuration of the identification address managed table 322 with which the gateway of this invention is equipped.

[0029] An identification address 400, an operating condition 401, an affiliation subnet 402, and each area of an expiration date 403 are consisted of by the identification address managed table 222. The identification address in use or the identification address which can be given to a mounted terminal is stored in the identification address 400. The information showing whether each identification address stored in the area of an identification address 400 is used for the mounted terminal is stored in the operating condition 401. When the identification address is used for the mounted terminal by the affiliation subnet 402, the subnet name to which the mounted terminal belongs is stored in it. The expiration date of the identification address currently used for the mounted terminal is stored in the expiration date 403.

[0030] Drawing 5 is drawing showing the configuration of the routing table 223 with which the gateway of this invention is equipped.

[0031] It consists of each area of the output destination change 501 which shows the identification address 500 of a mounted terminal, and the output destination change of a packet in routing table 223.

[0032] Drawing 6 is drawing showing the configuration of the routing table 322 with which the base station of this invention is equipped.

[0033] An identification address 600, an output destination change 601 which shows the output destination change of a packet, and each area of the existence 602 of a base station subordinate are consisted of by routing table 322. The information showing whether the mounted terminal which has each identification address stored in the identification address 600 exists in the subordinate of the base station is stored in the existence 602 of a base station subordinate.

[0034] Drawing 7 is drawing showing an example of the description of this invention.

[0035] The example shown in drawing 7 shows the terminal detection message 212 used when a mounted terminal moves between the base station in the same subnet, or a subnet. The terminal detection message 212 consists of the detection terminal identification address 700 which

stores the identification address of the detected mounted terminal, and each area of the message-sending former subnet name 701 which stores the subnet name by which the mounted terminal was detected.

[0036] In addition, although mentioned later, the message which it uses when the mounted terminal which has an identification address breaks away out of communication system (drawing 1) is called the identification address disconnection informative message 212. It is contained in the message 212 as an identification address which the identification address of the mounted terminal should open wide. The grant of the identification address opened wide to other mounted terminals is attained.

[0037] Drawing 8 is the flow Fig. showing actuation of communication system when a mounted terminal goes into the subordinate of a subnet (for example, subnet 110) for the first time.

[0038] Detection of a new mount terminal of the processor 320 with which the control section 303 of a base station 140-1 is equipped requires the identification address which can be given to the new mount terminal of the gateway 130 (S801). (step S800)

[0039] The processor 220 with which the control section 203 of the gateway 130 is equipped will acquire an empty identification address (for example, AA.AA.AA.AA) with reference to the operating condition 401 of the identification address managed table 222, if a demand is received (S802). Next, a processor 220 notifies the acquired identification address to a base station 140-1 (S803).

[0040] "AA.AA.AA.AA" will be set as the identification address 600 of routing table 322, and the processor 320 with which the control section 303 of a base station 140-1 is equipped will set "*" as the existence 602 of "a terminal interface 300-2" and a base station subordinate in an output destination change 601, respectively, if a notice is received (S804, drawing 6).

[0041] Moreover, the processor 220 with which the control section 203 of the gateway 130 is equipped sets "under use" as the operating condition 401 of "AA.AA.AA.AA", and sets "a subnet 210" as the affiliation subnet 402, respectively. Furthermore, a processor 220 sets "AA.AA.AA.AA" as the identification address 500 of routing table 223, and sets "the base station interface 200-2" as an output destination change 501 (S805, drawing 4 R> 4, drawing 5). Next, a processor 220 generates the packet 211 containing the terminal detection message 212 (drawing 7), and transmits to a base station 140-2 - addressing to 140-n (S806).

[0042] "AA.AA.AA.AA" will be set as the identification address 600 of routing table 322, and the processor 320 with which the control section 303 of a base station 140-2 - 240-n is equipped will set "nothing" as the existence 602 of "a terminal interface 300-2" and a base station subordinate in an output destination change 601, if a notice is received (S807, drawing abbreviation).

[0043] Moreover, the processor 220 with which the control section 203 of the gateway 130 is equipped transmits the above-mentioned packet 211 also to the gateway 131 and addressing to 132 (S808). This packet 211 is transmitted to the gateways 131 and 132 through the gateway connection network 121.

[0044] The processor 220 with which the control section 203 of the gateways 131 and 132 is equipped searches the identification address 400 of the identification address managed table 222 based on the detection terminal identification address "AA.AA.AA.AA" (drawing 7) included in the terminal detection message 212. When there is an identification address "AA.AA.AA.AA" which is in agreement with an identification address 700, a processor 220 sets "under use" as an operating condition 401. Moreover, a processor 220 sets "a subnet 110" as the affiliation subnet 502 based on the message-sending former subnet name "a subnet 110" included in the terminal detection message 212 (S809, drawing 4). In addition, when the corresponding identification address does not exist, a processor 220 newly creates an entry after the entry of the identification address which can be given. Based on the terminal detection message 212, "AA.AA.AA.AA" is set as an identification address 400 and, as for it, a processor 220 sets "a subnet 110" as an operating condition 401 "during use" at the affiliation subnet 402.

[0045] Furthermore, the processor 220 with which the control section 203 of the gateway 130 is equipped notifies an identification address "AA.AA.AA.AA" to the IP network 120 (S810). By the above actuation, the packet addressed to the above-mentioned mounted terminal from the IP

network 120 is transmitted to a mounted terminal through the gateway 130 and a base station 140-1.

[0046] Drawing 9 is the flow Fig. showing communication system actuation when a mounted terminal moves between the base stations in the same subnet (for example, subnet 110).

[0047] For example, when the mounted terminal 104 (identification address "AA.AA.AA.AA") moves to wireless zone 101-[of base station 140-n] n from the wireless zone 101-1 of a base station 140-1, the terminal interface 300-2 with which base station 140-n is equipped detects the mounted terminal 104 (S900). Next, the processor 320 with which the control section 303 of base station 140-n is equipped analyzes the message 212 which received, and detects an identification address "AA.AA.AA.AA" (S901). Next, a processor 320 carries out the multiple address transfer of the packet 211 containing the terminal detection message 212 (drawing 7) which made "the subnet 110" "AA.AA.AA.AA" and a message-sending former subnet name for the identification address at the gateway 130, a base station 140-1 - 140- (n-1) (S902, S903). Moreover, a processor 320 rewrites the existence 602 of the base station subordinate of routing table 322 from "nothing" to "**" (S904, drawing 11 R> 1).

[0048] Next, the processor 320 with which the control section 303 of a base station 140-1 - 140- (n-1) is equipped analyzes the terminal detection message 212 which received. A processor 320 searches the identification address 600 of routing table 322 based on the detection terminal identification address "AA.AA.AA.AA" included in the terminal detection message 212. When a processor 320 has an identification address "AA.AA.AA.AA" and the existence 602 of a base station subordinate serves as "**", "nothing" is set as the existence 602 of a base station subordinate (S905). Here, the existence 602 of the base station subordinate of the routing table 322 with which a base station 140-1 is equipped writes and replaces "nothing" from "**" (drawing 11).

[0049] Moreover, the processor 220 with which the control section 203 of the gateway 130 is equipped analyzes the terminal detection message 212 which received. A processor 220 checks that the message-sending former subnet name 701 contained in the terminal detection message 212 is "a subnet 110", and discards the terminal detection message 212 (S906). By the above actuation, the packet from the IP network 120 comes (drawing 11) to be transmitted to the mounted terminal 104 of a migration place through base station 140-n.

[0050] Drawing 10 is the flow Fig. showing actuation of the communication system at the time of moving between the subnets from which a mounted terminal differs.

[0051] For example, when the mounted terminal 104 (identification address "AA.AA.AA.AA") moves to the wireless zone 141-1 of the base station 141-1 belonging to a subnet 111 from wireless zone 140-[of base station 140-n belonging to a subnet 110] n, the terminal interface 300-2 with which a base station 141-1 is equipped detects the mounted terminal 104 (1000). Next, the processor 320 with which the control section 303 of a base station 141-1 is equipped analyzes the message 212 which received, and detects an identification address "AA.AA.AA.AA" (S1001). Next, a processor 320 carries out the multiple address transfer of the packet 211 containing the terminal detection message 212 which made "the subnet 111" "AA.AA.AA.AA" and a message-sending former subnet name for the identification address at the gateway 131, a base station 141-2 - 141-n (S1002, S1003). Moreover, a processor 320 sets "AA.AA.AA.AA" as the identification address 600 of routing table 322, and sets "**" as "the base station interface 300-2" and the existence 602 of a base station subordinate in an output destination change 601 (S1004, drawing 12).

[0052] The processor 220 with which the control section 203 of the gateway 131 is equipped analyzes the terminal detection message 212 which received. A processor 220 rewrites the affiliation subnet 402 of the identification address managed table 222 from a subnet 110 to a subnet 111 based on the contents of the terminal detection message 212 (drawing 12). Moreover, although not illustrated, "AA.AA.AA.AA" is set as the identification address 500 of routing table 223, and "the base station interface 200-2" is set as an output destination change 501 (S1005).

[0053] The processor 320 with which the control section 303 of a base station 141-2 - 141-n is equipped analyzes the terminal detection message 212 which received. Although not illustrated,

based on the contents of the terminal detection message 212, "AA.AA.AA.AA" is set as the identification address 600 of routing table 322, and a processor 320 sets "nothing" as the existence 602 of "a terminal interface 300-2" and a base station subordinate in an output destination change 601 (S1006).

[0054] Next, the processor 220 with which the control section 203 of the gateway 131 is equipped carries out the multiple address transfer of the packet 211 containing the terminal detection message 212 which made "the subnet 111" "AA.AA.AA.AA" and a message-sending former subnet name for the identification address after processing of S1005 in the gateways 130 and 132 belonging to other subnets 110 and 112 (S1007).

[0055] Next, the processor 220 with which the control section 203 of the gateways 130 and 132 is equipped analyzes the terminal detection message 212 which received. A processor 220 rewrites the affiliation subnet 402 corresponding to "AA.AA.AA.AA" in the identification address 400 of the identification address managed table 222 from a subnet 110 to a subnet 111 based on the contents of the terminal detection message 212 (S1008, drawing 12). In addition, in the gateway 132, although not shown clearly, since a moved material subnet is a subnet 110, processing is ended. In routing table 223, as for the gateway 130 belonging to the moved material subnet 110, an identification address 500 deletes the area of "AA.AA.AA.AA." Next, the processor 220 with which the control section 203 of the gateway 130 is equipped carries out the multiple address transfer of the terminal detection message 212 which received at a base station 140-1 - 140-n (1009).

[0056] Although not illustrated, as for the processor 320 with which the control section 303 of a base station 140-1 - 140-n is equipped, an identification address 500 deletes the area of "AA.AA.AA.AA" (S1010, drawing 12). Furthermore, the processor 220 with which the control section 203 of the gateway 131 is equipped notifies an identification address "AA.AA.AA.AA" after processing of S1007 (S1011). By the above actuation, the packet from the IP network 120 comes (drawing 11) to be transmitted to the mounted terminal 104 of a migration place through a base station 141-1.

[0057] Drawing 12 is the flow Fig. showing actuation when the expiration date 403 of an identification address carries out a time-out (the value of an expiration date 403 is zero).

[0058] For example, the processor 220 with which the control section 203 of the gateway 130 is equipped executes an ICMP echo command towards the terminal in which the affiliation subnet 402 of the identification address managed table 222 has this identification address when an expiration date 403 carries out a time-out about the entry of "the gateway 130" (1300). A processor 220 judges the existence of the response from a terminal (1301). If there is a response from a terminal, a processor 220 will reset an expiration date 403 to a certain fixed value (1302), and will notify the renewal of an expiration date 403 to the gateways 131 and 232 belonging to other subnets 111 and 112 (1303). The processor 220 with which the control section 203 of the gateways 131 and 232 which received the notice is equipped resets the expiration date 403 of the corresponding identification address to a certain fixed value (1310). The processor 220 with which the control section 203 of the gateway 130 will be equipped if a terminal to a response cannot be found judges whether it is the identification address which self gave from the entry location of the identification address managed table 322 (1304). If it is the identification address which self gave, the processor 220 with which the control section 203 of the gateway 130 is equipped will set the operating condition 401 of the identification address managed table 222 as an opening (1305). Moreover, with the identification address which self gave, if there is nothing, the processor 220 with which the control section 203 of the gateway 130 is equipped will delete the entry of this identification address of the identification address managed table 322 (1306). Then, the processor 220 with which the control section 203 of the gateway 130 is equipped deletes an element with this identification address from routing table 223 (1307). Furthermore, the processor 220 with which the control section 203 of the gateway 130 is equipped makes the open identification address contained in the identification address disconnection informative message 212 the identification address of the terminal which did not answer, and it sends out to the base station 140-1 in the same subnet 110 - 140-n, and the gateways 131 and 232 belonging to other subnets 111 and 112 by the multiple address (1308).

The processor 320 with which the control section 303 of the base station 140-1 - 140-n which received the identification address disconnection informative message 212 is equipped deletes an element with the identification address shown in the open identification address contained in the identification address disconnection informative message 212 from routing table 322 (1309). The processor 220 with which the control section 203 of the gateways 131 and 132 which received the identification address disconnection informative message 212 is equipped About the identification address shown in an open identification address, from the entry location of the identification address managed table 222 If it is the identification address which judged whether it was the identification address which the gateway 130 gave, and the gateway 130 gave The operating condition 401 of the identification address managed table 222 is set as an opening, and if it is not the identification address which the gateway 130 gave, the entry of this identification address of the identification address managed table 222 will be deleted (1310). The entry about the terminal which moved out of the network by the above actuation is deleted.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] Drawing showing the configuration of the whole communication system of this invention.

[Drawing 2] The block diagram showing the configuration of the gateway of this invention.

[Drawing 3] The block diagram showing the configuration of the base station of this invention.

[Drawing 4] Drawing showing the configuration of the identification address managed table of this invention.

[Drawing 5] Drawing showing the configuration of the routing table of this invention.

[Drawing 6] Drawing showing the configuration of the routing table of this invention similarly.

[Drawing 7] Drawing showing an example of a description.

[Drawing 8] The flow Fig. showing actuation of the communication system of this invention.

[Drawing 9] The flow Fig. showing actuation of the communication system of this invention similarly.

[Drawing 10] The flow Fig. showing actuation of the communication system of this invention similarly.

[Drawing 11] An output Fig. when a mounted terminal moves between base stations.

[Drawing 12] An output Fig. when a mounted terminal moves between subnets.

[Drawing 13] The flow Fig. showing actuation when the expiration date of an identification address carries out a time-out.

[Description of Notations]

100 [— IP network, 121 / — A gateway connection network, 130-132 / — The gateway, 140-1 - 140-n, 141-1 - 141-n, 142-1 - 142-n / — Base station.] — A vehicle, 104 — A mounted terminal, 110-112 — A subnet, 120

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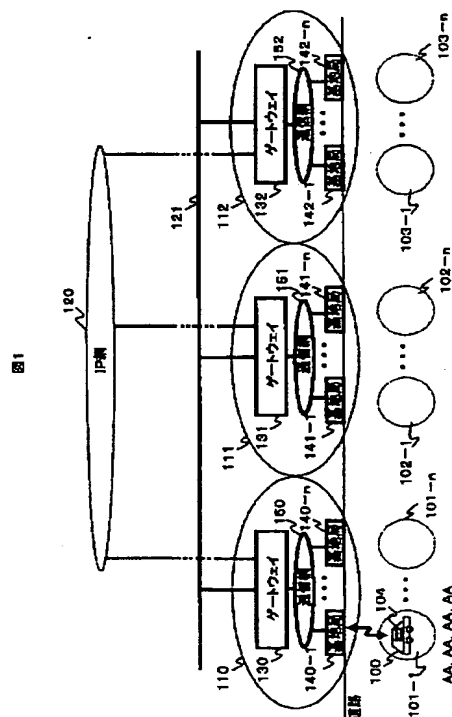
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(54) 【発明の名称】 通信システム

(57) 【要約】

【課題】短時間で、かつネットワークの使用効率を低下させることなく、ハンドオーバーの実現を可能とする通信システムを提供する。

【解決手段】基地局141-nは、基地局140-nの無線ゾーン101-nから移動してきた端末104およびその識別アドレスを検出すると、予め登録されている経路情報を書き換え、端末を検出した旨をゲートウェイ131に通知し、ゲートウェイ131は、予め登録されている端末情報および経路情報を書き換え、端末を検出した旨をゲートウェイ130とゲートウェイ132に通知する。



【特許請求の範囲】

【請求項1】複数の網から構成され、前記複数の網のそれぞれは複数の無線装置と前記複数の無線装置と接続された通信装置とから構成される通信システムであって、前記複数の網のうち第1の網における何れかの基地局は、第2の網からの端末を検出すると、予め登録された経路情報を書き換える手段と、前記端末の検出情報を前記第1の網における通信装置宛に送信する手段とを有し、

前記第1の網における前記通信装置は、前記端末の検出情報に基づき予め登録された経路情報を書き換える手段と、前記端末の検出情報を前記第1の網以外の網における通信装置のそれぞれに送信する手段を有することを特徴とする通信システム。

【請求項2】前記端末の検出情報を受信した前記第1の網以外の網における通信装置のそれぞれは、前記端末の検出情報に基づき予め登録された経路情報を書き換えることを特徴とする請求項1記載の通信システム。

【請求項3】前記第1の網における第1の無線装置は、前記第1の網における第2の無線装置の無線エリアからの端末を検出すると、予め登録されている経路情報を書き換える手段と、前記第1の網における前記第1の無線装置以外の無線装置に前記端末の検出情報を送信する手段とを有し、

前記第1の無線装置以外の前記無線装置のそれぞれは、前記端末の検出情報を受信すると、予め登録されている経路情報を書き換える手段を有することを特徴とする請求項1記載の通信システム。

【発明の詳細な説明】**【0001】**

【発明の属する技術分野】本発明は、高度道路交通システム(ITS: Intelligent Transport Systems)を実現する路車間通信システムに関する。

【0002】

【従来の技術】近年、安全性の向上、輸送効率の向上、快適性の向上を目指したサービスを実現するため、道路と車両を一体のシステムとした高度道路交通システムの開発が進められている。

【0003】その高度道路交通システムの一分野として、例えば、社団法人 電波産業会にて定められた標準規格「有料道路自動料金収受システム標準規格ARIBSTD-T551.2版」(平成11年12月14日1.2改定)に記載の自動料金収受システム(ETC: Electric Toll Collection System)が知られている。自動料金収受システムは、有料道路の料金所において、料金所を通過する車両が停止することなく、車両に搭載された車載端末(車載装置)と、料金所に設置された路側装置との間で狭域通信(DSRC: Dedicated Short Range Communication)と呼ばれる無線通信を行って、通行料金を自動収受する路車間システムである。

【0004】一方で、近年のインターネットの爆発的な普及に伴い、高度道路交通システムにIP(Internet Protocol)通信技術を適用して、音声、データ、画像等、様々な通信サービス(IPパケット通信)を実現したいとの要望がある。この場合には、車両に搭載された端末が移動しても通信の継続を可能とする技術(ハンドオーバー)が必要となる。

【0005】ハンドオーバーを実現する技術としては、例えば、「RFC(Request For Comment: インターネットに関する情報を伝える文書)2002」に規定のモバイル(Mobile)IP技術がある。本技術は、主に端末を本来使用している場所から一時的に移動して使用する場合を想定して開発されている。端末が管段所属しているネットワーク(ホームネットワーク: Home Network)にホームエージェント(HA: Home Agent)と呼ばれるノードを介在させる。又、移動先のネットワーク(フォアリンネットワーク: Foreign Network)にフォアリンエージェント(FA: Foreign Agent)と呼ばれるノードを介在させる。端末がホームネットワークからフォアリンネットワークに移動した場合におけるパケットの転送は、一旦ホームエージェントに送信した後、フォアリンエージェント宛に転送され、端末に送信される。

【0006】

【発明が解決しようとする課題】上述の狭域通信は、マイクロ波帯の電波を使用しているため、無線通信可能な範囲(無線ゾーン)が30mと小さく、かつ無線ゾーン同士の重なり範囲も無い。従って、車両が、このような複数の無線ゾーンを高速に移動しても途切れることなく継続してIP通信を可能とするためには、短時間でハンドオーバーを実現する必要がある。又、上記モバイルIP技術は、IPネットワークからのパケットが一旦ホームエージェントに集中する。従って、非常に多くの車両が高速に移動する路車間システムにモバイルIP技術を適用した場合、ホームエージェントの処理能力の低下、ひいてはネットワークの使用効率の低下を招くことになる。

【0007】以上の点に鑑みて、本発明の目的は、短時間でハンドオーバーを実現することの出来る通信システムを提供することにある。

【0008】本発明の他の目的は、ネットワークの使用効率を低下させることなく、ハンドオーバーを実現することの出来る通信システムを提供することにある。

【0009】

【課題を解決するための手段】上記課題を解決するために、本発明の通信システムは、複数のサブネットから構成され、前記複数のサブネットのそれぞれは複数の基地局と前記複数の基地局と接続されたゲートウェイとから構成される通信システムであって、前記複数のサブネットのうち第1のサブネットにおける何れかの基地局は、第2のサブネットからの端末を検出すると、予め登録さ

れた経路情報を書き換える手段と、前記端末の検出情報を前記第1のサブネットにおけるゲートウェイ宛に送信する手段とを有し、前記第1のサブネットにおける前記ゲートウェイは、前記端末の検出情報に基づき予め登録された経路情報を書き換える手段と、前記端末の検出情報を前記第1のサブネット以外のサブネットにおけるゲートウェイのそれぞれに送信する手段を有する。前記端末の検出情報を受信した前記第1のサブネット以外のサブネットにおけるゲートウェイのそれぞれは、前記端末の検出情報に基づき予め登録された経路情報を書き換える手段を有する。

【0010】又、前記第1のサブネットにおける第1の基地局は、前記第1のサブネットにおける第2の基地局の無線エリアからの端末を検出すると、予め登録された経路情報を書き換える手段と、前記第1のサブネットにおける前記第1の基地局以外の基地局に前記端末の検出情報を送信する手段とを有し、前記第1の基地局以外の前記基地局のそれぞれは、前記端末の検出情報を受信すると、予め登録された経路情報を書き換える手段を有する。

【0011】

【発明の実施の形態】以下、本発明による通信システムの実施形態について、図面を参照して詳細に説明する。

【0012】図1は、本発明の通信システム全体の構成を示す図である。

【0013】本発明の通信システムは、路車間システムにおいてIP通信を可能とすべく、ネットワーク110（以下、サブネット110と称する）と、サブネット111と、サブネット112と、IP網（例えば、モバイルIP網）120とから構成されている。サブネット110は、道路の路側に設置された複数の基地局（無線装置）140-1～140-nと、基地局140-1～140-nと接続された通信網150と、通信網150と接続されたゲートウェイ（通信装置）130とから構成されている。なお、図中、101-1～101-nは、それぞれ基地局140-1～140-nの無線ゾーンを示している。又、車100に搭載された車載端末104には、車載端末104を識別するための識別アドレス（例えば、AA.AA.AA.AA）が付与されている。サブネット111、サブネット112もサブネット110と同様の構成となっている。

【0014】又、本発明では、ゲートウェイ130～132は、IP網220と接続されている。更に、本発明では、ゲートウェイ130～132は、それぞれゲートウェイ間接続網221により相互接続されている。又、本発明では、ゲートウェイ130～132のそれぞれは、配下にある各基地局の宛先情報を管理している。ゲートウェイ130～132は、IP網220からのパケットを、それぞれ配下の各基地局宛に同報転送する。

【0015】詳細を後述するが、本発明による基地局1

40-1～140-nは、それぞれ配下における車載端末の経路情報を管理している。同一のサブネット内において、車載端末が基地局間を移動した場合、移動先基地局は端末およびその端末の識別アドレスを検出して、予め登録された車載端末の経路情報の内容を書き換える。又、移動先基地局は、同一サブネット内に属する他の基地局宛に、車載端末を検出した旨を通知する。端末検出通知を受けた他の基地局は、その内容に基づき車載端末の経路情報の内容を書き換える。以上の動作により、IP網120からのパケットが、移動先の車載端末に送信される。

【0016】又、ゲートウェイ130～132のそれぞれは、サブネットに属する車載端末の情報（例えば、識別アドレス）および経路情報を管理している。車載端末がサブネット間を移動した場合、移動先サブネットに属する基地局は、上記同様にして予め登録された経路情報を書き換える。又、上記基地局は、同一サブネット内のゲートウェイおよび他の基地局に車載端末の識別アドレスを通知する。通知を受けたゲートウェイは、端末情報および経路情報の内容を書き換え、車載端末を検出した旨を他のサブネットに属するゲートウェイに通知する。又、通知を受けた基地局は経路情報の内容を書き換える。他のサブネットに属するゲートウェイ、基地局も同様にして予め登録されている上記情報の内容を書き換える。以上の動作により、IP網120からのパケットが、移動先の車載端末に送信される。

【0017】図2は、本発明のゲートウェイ130の構成を示すブロック図である。ゲートウェイ131、ゲートウェイ132もゲートウェイ130と同様の構成となっている。

【0018】ゲートウェイ130は、IP網インタフェース200-1と、基地局インタフェース200-2と、ゲートウェイ間接続網インタフェース200-3と、ルーティング部201と、メッセージ処理部202と、制御部203とから構成されている。更に、制御部203は、プロセッサ220と、プログラム格納メモリ221と、識別アドレス管理テーブル222と、ルーティングテーブル223とを備え、ゲートウェイ130全体を統括的に制御する。

【0019】ここで、ゲートウェイ間接続網インタフェース200-3は、ゲートウェイ131又はゲートウェイ132から受信したパケット211をルーティング部201に送信する。上記パケット211には、識別アドレス管理テーブル222の内容（端末情報）およびルーティングテーブル223の内容（経路情報）を書き換えるための端末検出情報等のメッセージが含まれている。ルーティング部201は、ゲートウェイ間接続網インタフェース200-3から受信したパケット211をメッセージ処理部202に送信する。メッセージ処理部202は、ルーティング部201から受信したパケット21

1をメッセージ212に組み立てて制御部203に送信する。制御部203に備えるプロセッサ220は、メッセージの内容を解析して、識別アドレス管理テーブル222とルーティングテーブル223の内容を書き換える。

【0020】又、上記メッセージ処理部202は、制御部203から受信したメッセージ212をパケット211に組み立ててルーティング部201に送信する。ルーティング部201は、メッセージ処理部202から受信したパケット211をゲートウェイ間接続網インタフェース200-3に送信する。ゲートウェイ間接続網インタフェース200-3は、ルーティング部201から受信したパケット211をゲートウェイ接続網121に送信する。

【0021】次に、IP網220から受信したパケット210は、IP網インタフェース200-1を介してルーティング部201に送信される。ルーティング部201は、ルーティングテーブル223に基づき、IP網インタフェース200-1から受信したパケット210を基地局インタフェース200-2に交換（スイッチング）する。基地局インタフェース200-2は、ルーティング部201から受信したパケット210を基地局140-1～140-n宛に同報転送する。同様に、基地局140-1～140-nからのパケットは、基地局インタフェース200-2、ルーティング部201、IP網インタフェース200-1を介してIP網220に送信される。

【0022】なお、上述した基地局インタフェース200-1は、基地局毎に設けても良い。又、上述したメッセージ処理部202の処理は、制御部203で行うようにしても良い。

【0023】図3は、本発明の基地局140-1の構成を示すブロック図である。基地局140-2～24-nも基地局140-1と同様の構成となっている。

【0024】基地局140-1は、ゲートウェイ、基地局インタフェース300-1と、端末インタフェース300-2と、ルーティング部301と、メッセージ処理部302と、制御部303とから構成されている。更に、制御部303は、プロセッサ320と、プログラム格納メモリ321と、ルーティングテーブル322とを備え、基地局140-1全体を統括的に制御する。

【0025】なお、ルーティング部301、メッセージ処理部302、制御部303の各部における動作は、図2に示すルーティング部201、メッセージ処理部202、制御部203と同様であるので、ここでは詳細な説明は省略する。

【0026】メッセージを含むパケット211は、ゲートウェイ、基地局インタフェース300-1、ルーティング部301、メッセージ処理部302を介して制御部303に送信される。同様に、制御部303からのメッ

セージを含むパケットは、メッセージ処理部302、ルーティング部301を介してゲートウェイ、基地局インタフェース300-1に送信される。

【0027】又、IP網220からのパケット210は、ゲートウェイ、基地局インタフェース300-1、ルーティング部301を介して端末インタフェース300-2に送信される。端末インタフェース300-2は、ルーティング部301から受信したパケット210を車載端末に送信する。同様に、車載端末からのパケット210は、端末インタフェース300-2、ルーティング部301を介してゲートウェイ、基地局インタフェース300-1に送信される。

【0028】図4は、本発明のゲートウェイに備える識別アドレス管理テーブル322の構成を示す図である。

【0029】識別アドレス管理テーブル222には、識別アドレス400と、使用状況401と、所属サブネット402と、有効期限403の各エリアから構成されている。識別アドレス400には、使用中の識別アドレス、もしくは車載端末に付与可能な識別アドレスが格納されている。使用状況401には、識別アドレス400のエリアに格納されている各識別アドレスが車載端末に使用されているか否かを表す情報が格納されている。所属サブネット402には、識別アドレスが車載端末に使用されている場合、その車載端末の所属するサブネット名が格納されている。有効期限403には、車載端末に使用されている識別アドレスの有効期限が格納されている。

【0030】図5は、本発明のゲートウェイに備えるルーティングテーブル223の構成を示す図である。

【0031】ルーティングテーブル223には、車載端末の識別アドレス500と、パケットの出力先を示す出力先501の各エリアから構成されている。

【0032】図6は本発明の基地局に備えるルーティングテーブル322の構成を示す図である。

【0033】ルーティングテーブル322には、識別アドレス600と、パケットの出力先を示す出力先601と、基地局配下の存在602の各エリアから構成されている。基地局配下の存在602には、識別アドレス600に格納されている各識別アドレスを有する車載端末がその基地局の配下に存在するか否かを表す情報が格納されている。

【0034】図7は、本発明のメッセージ内容の一例を示す図である。

【0035】図7に示す例では、車載端末が同一サブネット内における基地局、もしくはサブネット間を移動した場合に使用する端末検出メッセージ212を示している。端末検出メッセージ212は、検出された車載端末の識別アドレスを格納する検出端末識別アドレス700と、車載端末が検出されたサブネット名を格納するメッセージ送信元サブネット名701の各エリアから構成さ

れている。

【0036】なお、後述するが、識別アドレスを有する車載端末が、通信システム（図1）外に離脱した場合に使用するメッセージを識別アドレス開放通知メッセージ212と称する。その車載端末の識別アドレスが開放すべき識別アドレスとしてメッセージ212に含まれている。開放された識別アドレスは、他の車載端末に付与可能となる。

【0037】図8は、車載端末が初めてサブネット（例えば、サブネット110）の配下に入った場合における通信システムの動作を示すフロー図である。

【0038】基地局140-1の制御部303に備えるプロセッサ320が新規車載端末を検出すると（ステップS800）、ゲートウェイ130にその新規車載端末に付与可能な識別アドレスを要求する（S801）。

【0039】ゲートウェイ130の制御部203に備えるプロセッサ220は要求を受けると、識別アドレス管理テーブル222の使用状況401を参照して、空きの識別アドレス（例えば、AA.AA.AA.AA）を取得する（S802）。次にプロセッサ220は、取得した識別アドレスを基地局140-1に通知する（S803）。

【0040】基地局140-1の制御部303に備えるプロセッサ320は通知を受けると、ルーティングテーブル322の識別アドレス600に“AA.AA.AA.AA”、出力先601に“端末インタフェース300-2”、基地局配下の存在602に“有”をそれぞれ設定する（S804、図6）。

【0041】又、ゲートウェイ130の制御部203に備えるプロセッサ220は、“AA.AA.AA.AA”の使用状況401に“使用中”、所属サブネット402に“サブネット210”をそれぞれ設定する。更に、プロセッサ220は、ルーティングテーブル223の識別アドレス500に“AA.AA.AA.AA”、出力先501に“基地局インタフェース200-2”を設定する（S805、図4、図5）。次に、プロセッサ220は、端末検出メッセージ212（図7）を含むパケット211を生成して、基地局140-2～140-n宛に送信する（S806）。

【0042】基地局140-2～240-nの制御部303に備えるプロセッサ320は通知を受けると、ルーティングテーブル322の識別アドレス600に“AA.AA.AA.AA”、出力先601に“端末インタフェース300-2”、基地局配下の存在602に“無”を設定する（S807、図省略）。

【0043】又、ゲートウェイ130の制御部203に備えるプロセッサ220は、上記パケット211をゲートウェイ131、132宛にも送信する（S808）。このパケット211は、ゲートウェイ間接続網121を介してゲートウェイ131、132に送信される。

【0044】ゲートウェイ131、132の制御部20

3に備えるプロセッサ220は、端末検出メッセージ212に含まれる検出端末識別アドレス“AA.AA.AA.AA”

（図7）に基づき、識別アドレス管理テーブル222の識別アドレス400を検索する。識別アドレス700に一致する識別アドレス“AA.AA.AA.AA”が有る場合、プロセッサ220は、使用状況401に“使用中”を設定する。又、プロセッサ220は、端末検出メッセージ212に含まれるメッセージ送信元サブネット名“サブネット110”に基づき、所属サブネット502に“サブネット110”を設定する（S809、図4）。なお、該当する識別アドレスが存在しない場合、プロセッサ220は、付与可能な識別アドレスのエントリ以降に新たにエントリを作成する。プロセッサ220は、端末検出メッセージ212に基づき、識別アドレス400に“A.AA.AA.AA.AA”、使用状況401に“使用中”、所属サブネット402に“サブネット110”を設定する。

【0045】更に、ゲートウェイ130の制御部203に備えるプロセッサ220は、IP網120に識別アドレス“AA.AA.AA.AA”を通知する（S810）。以上の動作により、IP網120からの上記車載端末宛のパケットは、ゲートウェイ130、基地局140-1を介して車載端末に送信される。

【0046】図9は、車載端末が同一サブネット（例えば、サブネット110）内の基地局間を移動した場合における通信システム動作を示すフロー図である。

【0047】例えば、車載端末104（識別アドレス“AA.AA.AA.AA”）が、基地局140-1の無線ゾーン101-1から基地局140-nの無線ゾーン101-nに移動した場合、基地局140-nに備える端末インタフェース300-2は、車載端末104を検出する（S900）。次に、基地局140-nの制御部303に備えるプロセッサ320は、受信したメッセージ212を解析して識別アドレス“AA.AA.AA.AA”を検出する（S901）。次に、プロセッサ320は、識別アドレスを“AA.AA.AA.AA”、メッセージ送信元サブネット名を“サブネット110”とした端末検出メッセージ212（図7）を含むパケット211を、ゲートウェイ130と基地局140-1～140-(n-1)に同報転送する（S902、S903）。又、プロセッサ320は、ルーティングテーブル322の基地局配下の存在602を“無”から“有”に書き換える（S904、図11）。

【0048】次に、基地局140-1～140-(n-1)の制御部303に備えるプロセッサ320は、受信した端末検出メッセージ212を解析する。プロセッサ320は、端末検出メッセージ212に含まれる検出端末識別アドレス“AA.AA.AA.AA”に基づき、ルーティングテーブル322の識別アドレス600を検索する。プロセッサ320は、識別アドレス“AA.AA.AA.AA”が有り、かつ基地局配下の存在602が“有”となっている

場合、基地局配下の存在602に“無”を設定する(S905)。ここでは、基地局140-1に備えるルーティングテーブル322の基地局配下の存在602が“有”から“無”に書き換わる(図11)。

【0049】又、ゲートウェイ130の制御部203に備えるプロセッサ220は、受信した端末検出メッセージ212を解析する。プロセッサ220は、その端末検出メッセージ212に含まれるメッセージ送信元サブネット名701が“サブネット110”であることを確認し、その端末検出メッセージ212を廃棄する(S906)。以上の動作により、IP網120からのパケットは、基地局140-nを介して移動先の車載端末104に送信されるようになる(図11)。

【0050】図10は、車載端末が異なるサブネット間を移動した場合における通信システムの動作を示すフロー図である。

【0051】例えば、車載端末104(識別アドレス“AA.AA.AA.AA”)が、サブネット110に属する基地局140-nの無線ゾーン140-nからサブネット111に属する基地局141-1の無線ゾーン141-1に移動した場合、基地局141-1に備える端末インタフェース300-2は、車載端末104を検出する(1000)。次に、基地局141-1の制御部303に備えるプロセッサ320は、受信したメッセージ212を解析して識別アドレス“AA.AA.AA.AA”を検出する(S1001)。次に、プロセッサ320は、識別アドレスを“AA.AA.AA.AA”、メッセージ送信元サブネット名を“サブネット111”とした端末検出メッセージ212を含むパケット211を、ゲートウェイ131と基地局141-2~141-nに同報転送する(S1002、S1003)。又、プロセッサ320は、ルーティングテーブル322の識別アドレス600に“AA.AA.AA.AA”、出力先601に“基地局インタフェース300-2”、基地局配下の存在602に“有”を設定する(S1004、図12)。

【0052】ゲートウェイ131の制御部203に備えるプロセッサ220は、受信した端末検出メッセージ212を解析する。プロセッサ220は、端末検出メッセージ212の内容に基づき、識別アドレス管理テーブル222の所属サブネット402をサブネット110からサブネット111に書き換える(図12)。又、図示していないが、ルーティングテーブル223の識別アドレス500に“AA.AA.AA.AA”、出力先501に“基地局インタフェース200-2”を設定する(S1005)。

【0053】基地局141-2~141-nの制御部303に備えるプロセッサ320は、受信した端末検出メッセージ212を解析する。図示していないが、プロセッサ320は、端末検出メッセージ212の内容に基づき、ルーティングテーブル322の識別アドレス600

に“AA.AA.AA.AA”、出力先601に“端末インタフェース300-2”、基地局配下の存在602に“無”を設定する(S1006)。

【0054】次に、ゲートウェイ131の制御部203に備えるプロセッサ220は、S1005の処理後、識別アドレスを“AA.AA.AA.AA”、メッセージ送信元サブネット名を“サブネット111”とした端末検出メッセージ212を含むパケット211を、他のサブネット110、112に属するゲートウェイ130、132に同報転送する(S1007)。

【0055】次に、ゲートウェイ130、132の制御部203に備えるプロセッサ220は、受信した端末検出メッセージ212を解析する。プロセッサ220は、端末検出メッセージ212の内容に基づき、識別アドレス管理テーブル222の識別アドレス400が“AA.AA.AA.AA”に対応する所属サブネット402をサブネット110からサブネット111に書き換える(S1008、図12)。なお、明示していないが、ゲートウェイ132においては、移動元サブネットはサブネット110であるので、処理を終了する。移動元サブネット110に属するゲートウェイ130は、ルーティングテーブル223において、識別アドレス500が“AA.AA.AA.AA”のエリアを削除する。次に、ゲートウェイ130の制御部203に備えるプロセッサ220は、受信した端末検出メッセージ212を基地局140-1~140-nに同報転送する(1009)。

【0056】図示していないが、基地局140-1~140-nの制御部303に備えるプロセッサ320は、識別アドレス500が“AA.AA.AA.AA”のエリアを削除する(S1010、図12)。更に、ゲートウェイ131の制御部203に備えるプロセッサ220は、S1007の処理後、識別アドレス“AA.AA.AA.AA”を通知する(S1011)。以上の動作により、IP網120からのパケットは、基地局141-1を介して移動先の車載端末104に送信されるようになる(図11)。

【0057】図12は、識別アドレスの有効期限403がタイムアウトした時(有効期限403の値がゼロ)の動作を示すフロー図である。

【0058】例えば、ゲートウェイ130の制御部203に備えるプロセッサ220は、識別アドレス管理テーブル222の所属サブネット402が“ゲートウェイ130”のエントリについて、有効期限403がタイムアウトした時には該識別アドレスを持つ端末に向けてICMPエコーコマンドを実行する(1300)。プロセッサ220は、端末からの応答の有無を判定する(1301)。端末から応答があれば、プロセッサ220は、有効期限403をある一定の値に再設定し(1302)、他のサブネット111、112に属するゲートウェイ131、232に有効期限403の更新を通知する(1303)。通知を受けたゲートウェイ131、232の制

御部203に備えるプロセッサ220は、該当する識別アドレスの有効期限403をある一定の値に再設定する(1310)。端末から応答が無ければ、ゲートウェイ130の制御部203に備えるプロセッサ220は、識別アドレス管理テーブル322のエントリ位置から、自己が付与した識別アドレスかどうかを判定する(1304)。自己が付与した識別アドレスならば、ゲートウェイ130の制御部203に備えるプロセッサ220は、識別アドレス管理テーブル222の使用状況401を空きに設定する(1305)。又、自己が付与した識別アドレスで無ければ、ゲートウェイ130の制御部203に備えるプロセッサ220は、識別アドレス管理テーブル322の該識別アドレスのエントリを削除する(1306)。その後、ゲートウェイ130の制御部203に備えるプロセッサ220は、ルーティングテーブル223から該識別アドレスを持つ要素を削除する(1307)。更に、ゲートウェイ130の制御部203に備えるプロセッサ220は、識別アドレス開放通知メッセージ212に含まれる開放識別アドレスを応答しなかった端末の識別アドレスとし、同一サブネット110内の基地局140-1~140-nと、他のサブネット111、112に属するゲートウェイ131、232に同報で送出する(1308)。識別アドレス開放通知メッセージ212を受信した基地局140-1~140-nの制御部303に備えるプロセッサ320は、ルーティングテーブル322から、識別アドレス開放通知メッセージ212に含まれる開放識別アドレスに示される識別アドレスを持つ要素を削除する(1309)。識別アドレス開放通知メッセージ212を受信したゲートウェイ131、132の制御部203に備えるプロセッサ220は、開放識別アドレスに示される識別アドレスについて、識別アドレス管理テーブル222のエントリ位置から、ゲートウェイ130が付与した識別アドレスかどうかを判定し、ゲートウェイ130が付与した識別アドレスならば、識別アドレス管理テーブル222の使用状況401を空きに設定し、ゲートウェイ130が付与した識別アドレスでなければ、識別アドレス管理テーブル222の該識別アドレスのエントリを削除する(131

0)。以上の動作によりネットワーク外に移動した端末についてのエントリは削除される。

【0059】

【発明の効果】本発明によると、短時間でハンドオーバーを実現することのできる通信システムを提供することが出来る。

【0060】又、本発明によると、ネットワークの使用効率を低下させることなく、ハンドオーバーを実現することのできる通信システムを提供することが出来る。

【図面の簡単な説明】

【図1】本発明の通信システム全体の構成を示す図。

【図2】本発明のゲートウェイの構成を示すブロック図。

【図3】本発明の基地局の構成を示すブロック図。

【図4】本発明の識別アドレス管理テーブルの構成を示す図。

【図5】本発明のルーティングテーブルの構成を示す図。

【図6】同じく、本発明のルーティングテーブルの構成を示す図。

【図7】メッセージ内容の一例を示す図。

【図8】本発明の通信システムの動作を示すフロー図。

【図9】同じく、本発明の通信システムの動作を示すフロー図。

【図10】同じく、本発明の通信システムの動作を示すフロー図。

【図11】車載端末が基地局間を移動した場合の出力図。

【図12】車載端末がサブネット間を移動した場合の出力図。

【図13】識別アドレスの有効期限がタイムアウトした時の動作を示すフロー図。

【符号の説明】

100…車、104…車載端末、110~112…サブネット、120…IP網、121…ゲートウェイ間接続網、130~132…ゲートウェイ、140-1~140-n、141-1~141-n、142-1~142-n…基地局。

【図5】

図5

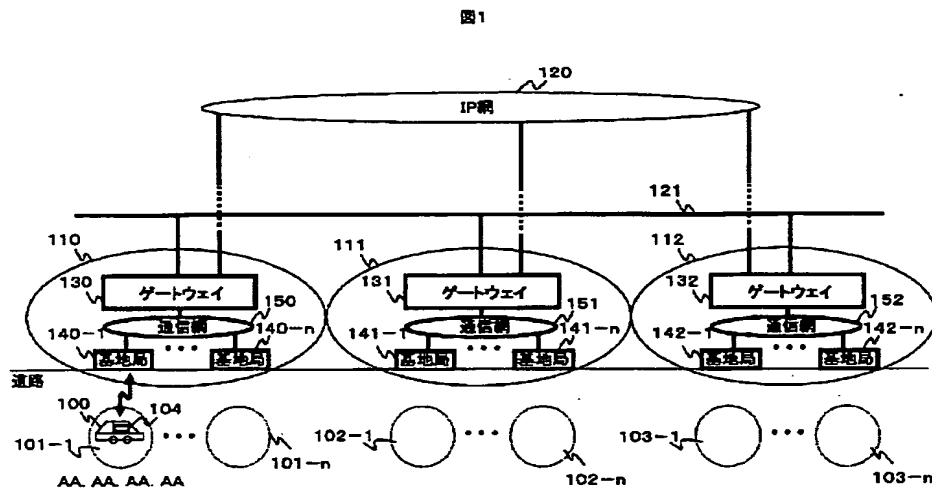
223 識別アドレス	500 出力先
AA.AA.AA.AA	基地局インタフェース200-2
.	.
.	.

【図6】

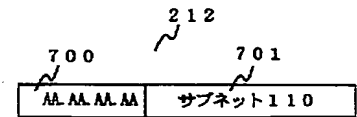
図6

600 識別アドレス	322 出力先	601 基地局配下の存在
AA.AA.AA.AA	端末インタフェース300-2	有
.	.	.
.	.	.

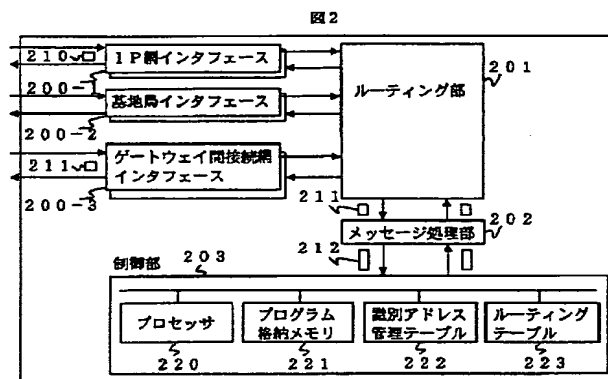
【図1】



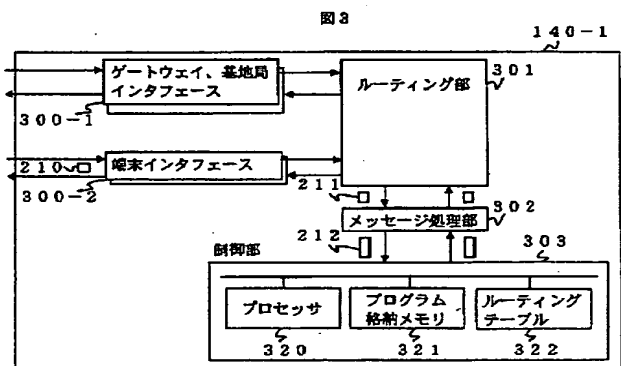
【図7】



【図2】



【図3】

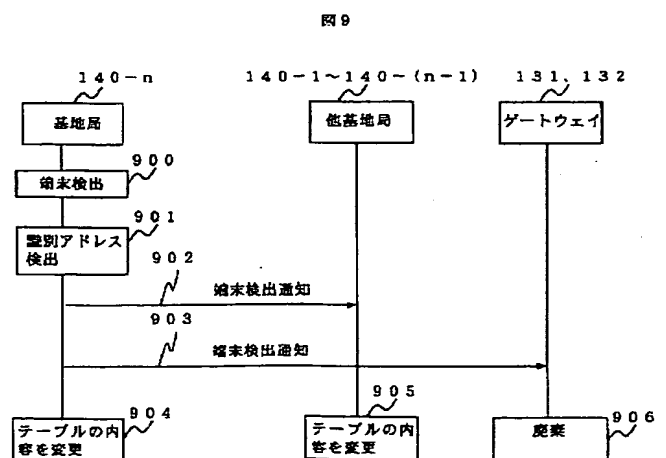


【図4】

図4

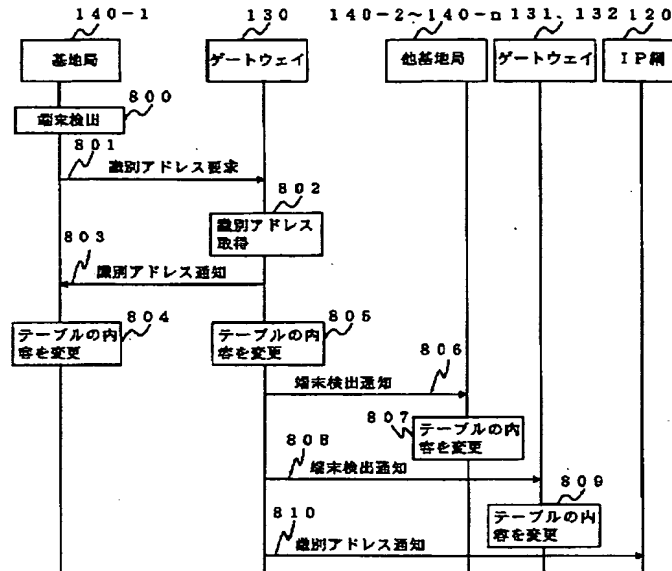
識別アドレス	使用状況	所属サブネット	有効期限
AA.AA.AA.AA	使用中	サブネット210	cc
BB.BB.BB.BB	空き		
...
ZZ.ZZ.ZZ.ZZ	空き		

【図9】



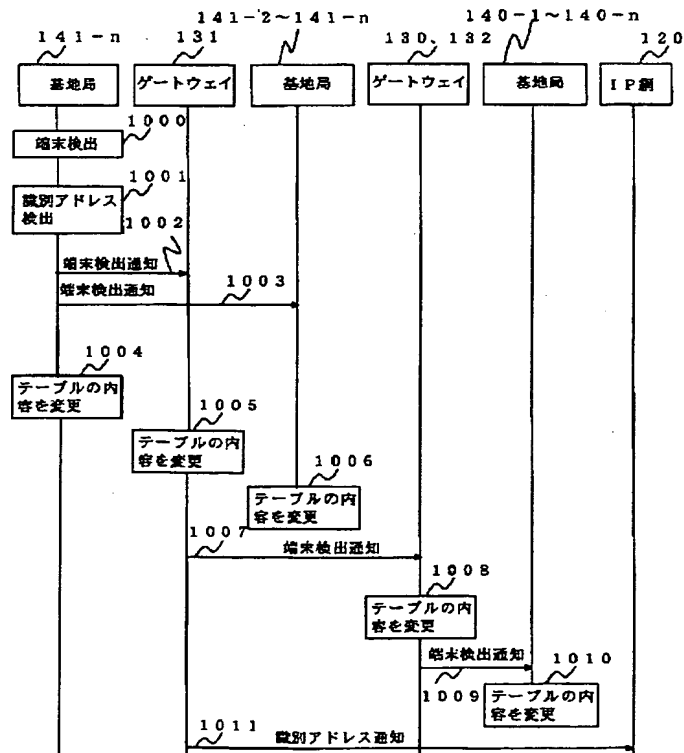
【図8】

図8



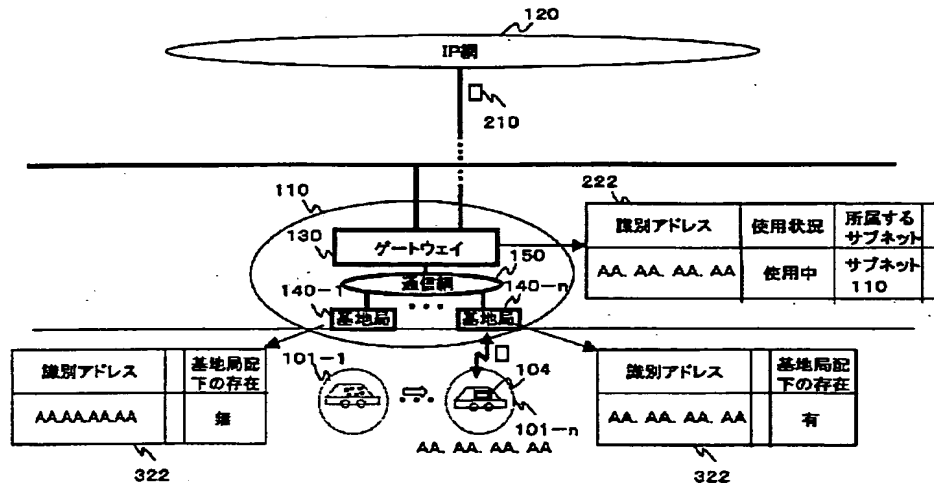
【図10】

図10



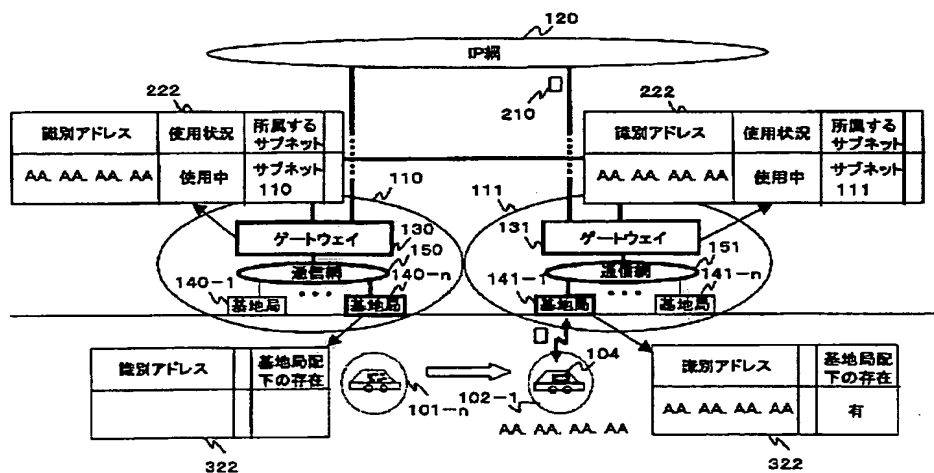
【図11】

図11

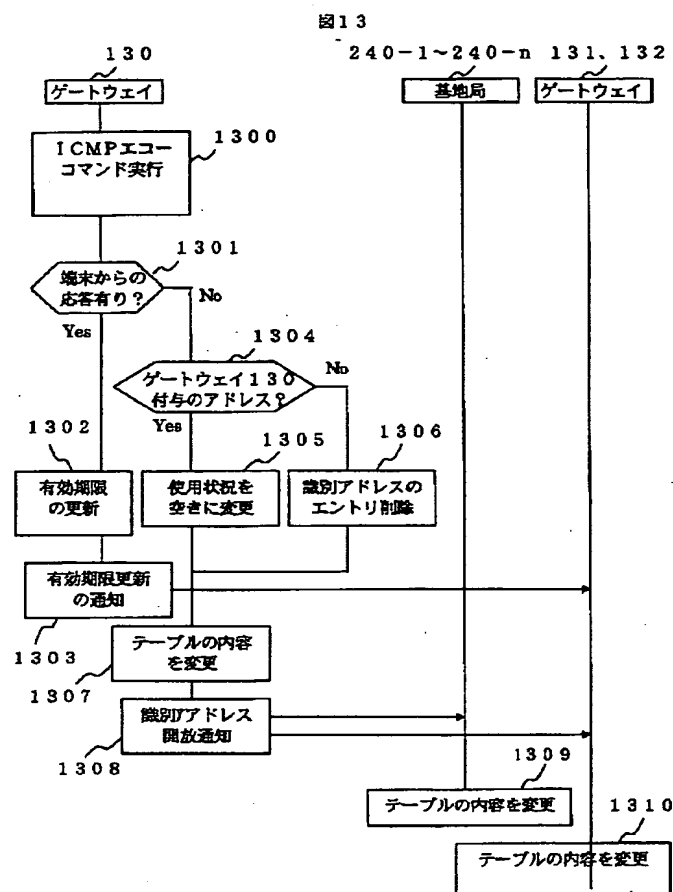


【図12】

図12



【図13】



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EE10 EE16 FF02 HH11 HH22
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JJ76